

# Rotate To Prevent Replant?

**G**rowers of the nation's largest crop of apples—in Washington State—may benefit by planting another top Pacific Northwest commodity: wheat.

But the wheat in this case wouldn't be a typical for-profit crop. Grown instead as a rotation or cover crop in the orchard, it might help prevent replant disease, a crippling condition that strikes young orchards. And it could serve as an alternative to methyl bromide and other soil fumigants typically used to sterilize old orchards before planting new trees.

The idea comes from Mark Mazzola, a plant pathologist at the Agricultural Research Service's Tree Fruit Research Laboratory in Wenatchee, Washington. He's discovered that in the Pacific Northwest, replant disease seems to be caused by buildup of a complex of four types of soilborne fungi: *Cylindrocarpon*, *Phytophthora*, *Pythium*, and *Rhizoctonia*.

"Apple trees seem to change the soil in a way that favors these pathogens," Mazzola says. "Some wheat varieties, on the other hand, modify the soil environment to the benefit of different microorganisms."

Specifically, he found a bacterium in some wheat soils, *Pseudomonas putida*, that can protect young apple roots from these fungi. ARS has patented use of a strain of this bacterium to prevent replant disease.

## Searching for Root Causes

When nothing is done between taking out an old orchard and putting in a new one, the young trees often become stunted and their root systems are small and decayed. For years, scientists have debated whether the cause was biological—a disease or organism—or a result of abiotic factors such as soil chemistry.

"Since methyl bromide and fungicides that suppress microbes seem to improve apple trees' health, it now looks like the cause is something biological,"

says Mazzola. "That cause may vary from place to place. In the Northeast, for example, nematodes may cause a problem. Here in Washington, specific groups of fungi seem to be the primary culprits."

But methyl bromide is due to be phased out by 2005. Other common pesticides used in the Northwest's orchards may also be taken off the shelf because of environmental concerns. For that reason, and to support the region's organic growers, Mazzola is looking for a nonchemical approach to prevent replant disease.

And his search is becoming more urgent all the time.

"Years ago, growers might have left an orchard in for several decades," Mazzola says. "But to meet market demands, some growers now pull out old orchards and plant new varieties much sooner."

Growers produce at least a dozen commercial varieties in Washington's billion-dollar-per-year apple industry. About half of the nation's apples are produced here on about 180,000 acres. About 10,000 acres of apples are replanted each year.

## The Problem Intensifies Over Time

If a new orchard is planted on ground that was previously used for something else, the harmful fungi don't build up fast enough to hurt the trees before they get established. But if trees are planted into an existing or previous apple orchard, the fungal population prevents the young, new trees from growing well.

It is accepted among scientists that chemicals exuded from plants affect the soil that surrounds them, favoring specific populations of microorganisms. Although the specific selective chemicals have not been identified, Mazzola has found that after an orchard has been in place about 3 years, apples promote a fungal population that can cause replant disease. He's studied 18 orchards in Washington, in collaboration with

Wenatchee Valley College and David Granatstein, director of Washington State University's Center for Sustainable Agriculture and Natural Resources in Wenatchee.

Now Mazzola is looking at how long wheat would have to be grown as a rotation crop to change the soil microbial community enough to stave off replant disease. Alternatively, he'll look at whether growing the wheat as a cover crop in existing orchards can reduce fungal populations sufficiently to allow new trees to grow well. He doesn't anticipate that apple growers would harvest the wheat as a crop, but says that would be up to the individual.

Theoretically, if young trees are given a good start, they'll be able to grow—despite the harmful fungi—when they're older. But Mazzola speculates that continuing to keep populations of these fungi low might improve yield, even in mature trees. Although greenhouse tests have indicated the strategy has merit, he doesn't advocate that growers abandon fungicides and rely on wheat until he has conclusive evidence in a field situation.

"Washington has a progressive apple industry, and they're really interested in this work," Mazzola says.

Next he'll try to identify why some wheat cultivars work while others have little or no effect. So far, he hasn't found any commonality among wheat types—such as hard red or soft white—only that some varieties provide a good environment for *P. putida* while others don't. —By **Kathryn Barry Stelljes**, ARS.

*This research is part of Plant Disease (#303) and Methyl Bromide Alternatives (#308), two ARS National Programs described on the World Wide Web at <http://www.nps.ars.usda.gov/programs/cppvs.htm>.*

*Mark Mazzola is with the USDA-ARS Tree Fruit Research Laboratory, 1104 N. Western Ave., Wenatchee, WA 98801; phone (509) 664-2280, fax (509) 664-2287, e-mail [mazzola@tfrl.ars.usda.gov](mailto:mazzola@tfrl.ars.usda.gov).* ♦





**Above: Plant pathologist Mark Mazzola prepares to evaluate the root system of young apple trees in a wheat rotation test plot. The roots will be examined to determine whether the rotation crop effectively suppressed root infection by the fungal complex that causes replant disease.**

**Below left: Mazzola measures trunk diameter as an indicator of growth rate in trees from wheat rotations.**  
**Below right: Technician Sheila Ivanov uses gas chromatography to identify bacteria isolated from apple roots.**

